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Indian Standard

METHOD FOR TRANSVERSE TESTING OF HARD METALS

(*First Revision*)

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March 1983

Indian Standard

METHOD FOR TRANSVERSE TESTING OF HARD METALS

(First Revision)

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Indian Standard

METHOD FOR TRANSVERSE TESTING OF HARD METALS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 15 December 1982, after the draft finalized by the Powder Metallurgical Materials and Products Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1968. In light of the experience gained in the field of Powder Matallurgy in subsequent years, this standard has been revised. In the revision of this standard assistance has been derived from ISO 3327-1975 'Hardmetals — Determination of transverse rupture strength', issued by the International Organisation for Standardization.

0.3 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard relates to the determination of transverse rupture strength of hard metals having negligible ductility.

NOTE — Repeated measurements carried out in accordance with this test method have shown a standard deviation amounting to 10 to 12 percent of the mean value.

2. PRINCIPLE OF TEST

2.1 The test consists of positioning of a test piece on two supports, applying a load at the mid point of the span and increasing the load until the test piece breaks.

---

*Rules for rounding off numerical values (*revised*).

3. REFERENCE SYMBOLS

3.1 The reference symbols used in this standard are given in Table 1.

TABLE 1 REFERENCE SYMBOLS

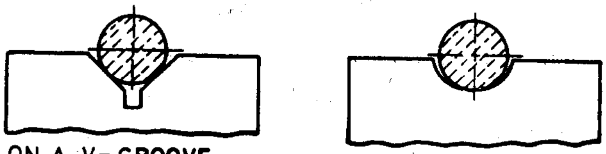
Symbol	Description	Unit
L	Length of span between suppports	mm
a	Thickness of test piece	mm
b	Width of test piece	mm
F	Load required to fracture the test piece	N
K	Correction factor (*see* Note 1 under 7)	—
Rtr	Transverse rupture strength	N/mm^2

$$Rtr = \frac{3FL}{2a^2.b} \times K$$

4. TEST APPARATUS

4.1 The testing equipment shall have a static condition of loading and an accuracy of ±1 percent.

4.2 The test apparatus shall comprise of two support cylinders (rollers) and a load cylinder (roller). The support cylinders and the load cylinder, shall be made of hard metal, shall not deform and shall be of same diameter. They shall be between 3 to 6 mm in diameter and at least 10 mm long. The support cylinders, which are lying freely (*see* Fig. 1), shall be mounted with their length axis parallel. The surface finish of the rollers shall be such that no notch formation occurs in specimen during loading. The span between them shall be 14·5 ± 0·5 mm and shall be determined to an accuracy of ±0·1 mm.



ON A V-GROOVE

Inside a cylindrical hole with sufficient clearance, so that, the line of contact is in the lowest region.

FIG. 1 MOUNTING ARRANGEMENT

4.3 The load cylinder shall be mounted so that its length axis is parallel to the length axes of the support cylinders. It shall also be mounted so that the load can be applied within ±0·2 mm of the mid point of the span. The holder for the load cylinder shall be jointed (*see* Fig. 2). The load cylinder holding blocks shall be guided vertically using guide pillars fixed rigidly to the bottom holder of support cylinders.

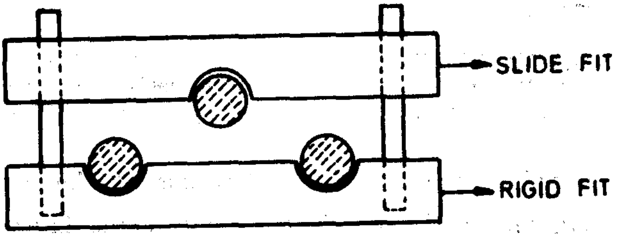


FIG. 2 TEST ARRANGEMENT

5. TEST PIECE

5.1 The test piece shall have a rectangular cross section. It shall be 20 ± 1 mm long, 5·25 ± 0·25 mm thick and 6·50 ± 0·25 mm wide. Its thickness and width shall be determined to an accuracy of ±0·025 mm.

5.2 The test piece shall preferably be used with its surface in the 'as sintered' condition. The long edges of 'as sintered' test pieces shall be chamfered from 0·4 to 0·5 mm, at an angle of 45°.

5.2.1 Surface treatments introducing high stress shall be avoided. If however, the four long faces are to be ground, the following procedure may be applied.

5.2.1.1 A free cutting diamond wheel with ceramic bond and 150 mesh grain size (approximately 88 to 105 microns) is recommended. The test piece shall be ground on the peripheral face of the wheel with the grinding marks parallel to the test piece length axis. The maximum depth of cut shall be 0·02 mm. The grinding wheel periphery speed shall be about 20 m/s. Copious amount of coolant shall be applied during grinding.

NOTE — Ground test pieces may be chamfered to only 0·15 to 0·20 mm, at an angle of 45°. The same care shall be taken in grinding the chamfer as the long faces.

5.2.2 *Visual Examination* — The material shall be visually inspected for the presence of any surface flaws, cracks and other structural defects.

6. TEST PROCEDURE

6.1 The test piece shall be laid flat on the support cylinders with the wider face so that its length axis is perpendicular to their length axes. The load shall be applied so that contact is made without substantial impact and gradually increased until the test piece breaks. The load shall be increased at a uniform rate providing a stress increase of less than 100 N/mm^2 per second. Six independent determinations shall be made.

NOTE — The point of application of the load shall not exceed 0·2 mm from the middle of the span.

7. TEST RESULTS

7.1 The transverse rupture strength for the six test pieces shall be calculated and the obtained values shall be designated as x_1, x_2, etc, in ascending order. The arithmatic mean of x_3 and x_4 shall be reported as the test result.

7.2 The standard deviation, as given below, may also be reported.

If x_1, x_2, x_3, x_4, x_5 and x_6 are the test results on the six test pieces, the standard deviation is calculated as follows:

$$Sd = \sqrt{\frac{\sum_{i=1}^{6} x_i^2 - \frac{\left(\sum_{i=1}^{6} x_i\right)^2}{6}}{5}}$$

NOTE 1 — The correction factor 'K' which arises, because of the existence of the chamfer on the test piece, is as given below:

Chamfer	*Correction Factor 'K'*
0·4 to 0·5 mm	1·02
0·15 to 0·2 mm	1·00

NOTE 2 — By using the two values x_3 and x_4 in calculation of the transverse rupture strength the influence of extreme values is minimized. However, in determining the standard deviation no value should be discarded.

NOTE 3 — If the fracture occurs in the tension side of the test piece at a point whose distance from the line of application of the load is more than 2·5 mm, then the test shall be discarded.

8. TEST REPORT

8.1 The test report shall include the following details:

a) Reference to this Indian standard;
b) Information regarding the identity of the sample;
c) The type of test pieces and the method used for the preparation of their surfaces;
d) The method of applying the load; and
e) The result obtained.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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